

CLAIMS

What Is Claimed Is:

1. An optical modulator comprising:
a first substrate having a movable reflective film that oscillates in accordance with the application of an electrostatic force;
a light-transmitting second substrate disposed so as to oppose said first substrate and formed with a transparent electrode for applying said electrostatic force, in a position corresponding to said movable reflective film; and
a cavity section, demarcated by said first substrate and said second substrate, for restricting the range of oscillation of said movable reflective film.
2. The optical modulator according to claim 1, wherein the cavity section for restricting the range of oscillation of said movable reflective film is constituted by a recess section or groove section provided in said second substrate, and a flat face of said first substrate, said movable reflective film being formed in a position of said first substrate corresponding to an opening of said recess section or groove section in said second substrate.
3. The optical modulator according to claim 1, wherein the cavity section for restricting the range of oscillation of said movable reflective film is constituted by a recess section or groove section provided in said first substrate, and a flat face of said second substrate, said movable reflective film being formed on the face of said recess section or groove section in said first substrate.
4. An optical modulator comprising:
a first substrate having, on one face thereof, a single first groove or a plurality of first grooves, each having a movable reflective film that oscillates in accordance with electrostatic force formed on the bottom face thereof; and
a light-transmitting second substrate, positioned so as to oppose said first substrate, having a single second groove or a plurality of second grooves provided on the face thereof opposing said first substrate, each of said second grooves extending in a direction approximately orthogonal to said first grooves and having a transparent electrode formed on the bottom face thereof.

5. The optical modulator according to claim 1, wherein said movable reflective film is formed from either a conductive film, or a semiconductor film doped with an impurity, or a dielectric film, or a laminated film combining these films.

6. The optical modulator according to claim 1, wherein said first substrate is formed from a semiconductor substrate.

7. The optical modulator according to claim 6, wherein said first substrate is formed from a semiconductor substrate of one polarity, and said movable reflective film is formed from a semiconductor film of the other polarity.

8. The optical modulator according to claim 6, wherein said semiconductor substrate is a silicon substrate.

9. The optical modulator according to claim 1, wherein said first substrate and said second substrate are bonded together by anodic bonding.

10. The optical modulator according to claim 1, wherein said second substrate is made of borosilicate glass.

11. The optical modulator according to claim 1, wherein a light absorber is formed on the upper face of said transparent electrode.

12. A display device formed by incorporating an optical modulator according to claim 1.

13. A method for manufacturing an optical modulator comprising:
a first substrate forming step for forming a first substrate having a movable reflective film that oscillates in accordance with the application of electrostatic force;
a second substrate forming step for forming a second substrate comprising a transparent electrode for applying said electrostatic force; and
a bonding step for bonding said first and second substrates together in mutually aligned positions in such a manner that said movable reflective film and said transparent electrode oppose each other.

14. The method for manufacturing an optical modulator according to claim 13, wherein said first substrate forming step comprising the steps of:

forming an etching prevention film by doping an impurity into the region on one side of a semiconductor substrate on which said movable reflective film is to be formed; and

forming a movable reflective film by performing etching of said semiconductor substrate from the other side of said semiconductor substrate until said etching preventing film, and making said etching prevention film oscillatable.

15. The method for manufacturing an optical modulator according to claim 14, further comprising the step of forming an insulating film on said etching prevention film.

16. The method for manufacturing an optical modulator according to claim 13, wherein said second substrate forming step comprises the steps of:

forming a recess section or groove section by patterning a transparent substrate in accordance with the disposition of the movable reflective film in said first substrate;

forming a transparent electrode film inside the recess section or groove section of said transparent electrode; and

forming an absorbing film for absorbing incident light under prescribed conditions, on the transparent electrode film inside the recess section or groove section of said transparent substrate.

17. The optical modulator according to claim 4, wherein said movable reflective film is formed from either a conductive film, or a semiconductor film doped with an impurity, or a dielectric film, or a laminated film combining these films.

18. The optical modulator according to claim 4, wherein said first substrate is formed from a semiconductor substrate.

19. The optical modulator according to claim 18, wherein said first substrate is formed from a semiconductor substrate of one polarity, and said movable reflective film is formed from a semiconductor film of the other polarity.

20. The optical modulator according to claim 18, wherein said semiconductor substrate is a silicon substrate.

21. The optical modulator according to claim 4, wherein said first substrate and said second substrate are bonded together by anodic bonding.

22. The optical modulator according to claim 4, wherein said second substrate is made of borosilicate glass.

23. The optical modulator according to claim 4, wherein a light absorber is formed on the upper face of said transparent electrode.

24. A display device formed by incorporating an optical modulator according to claim 4.